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INSTRUMENT FOR MEASURING THE SMOOTHNESS OF PAPER

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The invention relates to the field of testing paper and can be used in the pulp and paper industry.

There is a known instrument for measuring the smoothness of paper that consists of a measurement vacuum chamber connected to a vacuum pump and a glass plate, a weight for clamping the sample, a vacuum-to-pulse length converter with a Bourdon tube connected to a measurement chamber and, connected in series, a reference oscillator, a switch, vacuum threshold measurement circuit and time measurement counter [1].

The shortcoming of the known device is its low measurement accuracy.

The goal of the invention is an improvement of the measurement accuracy by increasing sensitivity.

This goal is achieved by the fact that the vacuum-to-pulse length converter includes two reference voltage sources, two current sources of opposite polarity, a controlled current source, connected in series to the reference voltage source, a control circuit, the input of which is connected to the reference voltage source, a commutator and a flip-flop, and the Bourdon tube is connected with measurement and shield electrodes, and the shield electrode is connected to the common bus and the measurement electrode is connected to the outputs of the opposite polarity sources, the controlled current source, the second input of the reference circuit and the input of the commutator, the output of which is connected to the common bus, and the second input of the commutator is connected to one of the outputs of the flip-flop, the second output of which is connected to the switch, and the input is connected to the output of the reference circuit and to the output of the reference voltage circuit which is connected to the input of the controlled current source.

The drawing shows a block diagram of the instrument for measuring the smoothness of paper.

The instrument consists of weight 1 for clamping the sample of paper 2, glass plate 3, valve 4, measurement vacuum chamber 5, vacuum pump 6, reference oscillator 7, switch 8, vacuum threshold measurement circuit 9, time counter 10, vacuum-to-pulse length converter, which includes Bourdon tube 11, two reference voltage sources 12 and 13, two current sources 14 and 15 of opposite polarity, controlled current source 16, reference circuit 17, commutator 18, and RS flip-flop 19. Bourdon tube 11 is provided with two electrodes—measurement electrode 20 and shield electrode 21. The measurement electrode 20 is situated along the movable end of the Bourdon tube. Shield electrode 21 is arranged so that it completely covers the measurement electrode. The Bourdon tube, which is the first electrode, and the shield electrode are connected to the common bus. The measurement electrode is connected to the outputs of the three current sources 14-16 (point A).

In this way, the capacitance sensor consists of two capacitors connected in parallel.

At the center of the glass plate there is a hole that is connected via valve 4 to the measurement vacuum chamber 5. The chamber is connected to Bourdon tube 11. One input of commutator 18 is connected to the first input of RS flip-flop 19, while the other is connected to the outputs of current sources 14-16, and the output of the commutator is connected to the common bus. The output of reference circuit 17 is connected to the R input of flip-flop 19, the inverse output of which is connected to one of the inputs of switch 8. The output of the switch is connected to vacuum threshold measurement circuit 9, both outputs of which are connected to the time counter 10.

The device operates in the following way.

Paper is pressed to glass plate 3 by weight 1. A vacuum is created beforehand in the measurement vacuum chamber 5 by pump 6. Chamber 5 is connected via valve 4 to the hole in the center of glass plate 3. Atmospheric air is drawn between the surface of glass plate 3 and the surface of paper 2 into the hole in the center of plate 3, and the vacuum in chamber 5 drops. Chamber 5 is connected to the vacuum-to-pulse length converter, at the output of which pulses are formed, with the length of these pulses being proportional to the vacuum in chamber 5. The basis of the instrument is the principle of measuring the time during which the vacuum changes from a level of 480 mm Hg to a level of 282 mm Hg. This time is proportional to the smoothness. Pulses whose duration is proportional to the amount of vacuum in chamber 5 opens switch 8, which is transmitting pulses from reference oscillator 7 to the vacuum threshold measurement circuit 9. Circuit 9 forms a pulse when the vacuum in chamber 5 is equal to 480 mm Hg, which actuates time counter 10. When the lower limit of 282 mm Hg is reached, circuit 9 produces a second pulse, which stops time counter 10. Depending on the amount of vacuum, the end of the Bourdon tube connected to chamber 5 moves, and this movement is converted to a parameter of the electrical circuit by the capacitance sensor formed by the body of the Bourdon tube and the measurement electrode 20 and the shield electrode 21. In the initial state, point A of the vacuum-to-pulse length converter is connected to the common bus, since commutator 18 is open in the starting state. When a timing pulse appears at the S input of flip-flop 19, the flip-flop is set to a "one" state, and commutator 18 is closed. When this is done, the capacitance sensor begins to be charged from current sources 14 and 16, which have the same polarity. Current source 16 is controlled by reference voltage source 12. As the capacitance sensor becomes charged, the voltage on it increases. When this voltage reaches a value (for example 1 V) equal to the voltage of reference voltage source 13, reference circuit 17 actuates, forming a pulse. This pulse goes to the R input of flip-flop 19 and sets it to the "zero" state. In this way, a pulse whose duration is proportional to the capacitance is formed at the inverse output, and the value of the capacitance is dependent on a position of the end of the Bourdon tube, i.e., on the amount of vacuum. Current source 15 is also connected to point A. The polarity of current source 5 [sic; 15] is inverse to the polarity of current sources 14 and 16. The charge of the capacitor is not a linear process, but rather exponential, and the conversion of the vacuum to capacitance also is nonlinear. These nonlinearities are partially eliminated by supplying a charge current of opposite polarity from current source 15 to the capacitance sensor. One can experimentally find an inverse current such that the duration of the pulse formed by the converter will be practically linearly dependent on the magnitude of the capacitance and the vacuum. Two current sources 14 and 16 are used to adjust the beginning of the scale. Current source 16 can be regulated and is controlled by reference voltage source 12. The current of source 14 is chosen so that even when the current

of source 16 is absent, the sum of the currents of sources 14 and 15 will charge the capacitors. The use of source 16 makes it possible to regulate the beginning of the scale within significant limits. If current source 14 were absent, then the limits for controlling the beginning of the scale would be substantially narrower, since a change of the total current at point A to opposite polarity is possible, which would disrupt the principle of operation of the vacuum-to-pulse length converter.

The forces of attraction and mutual influence between the moving end of the Bourdon tube and the measurement electrode are very negligible and introduce practically no error into the measurement process. The use of three current sources makes it possible to regulate the charging current of the capacitance within a significant range, i.e., to increase or decrease the pulse duration. By choosing specific charge currents with a specific capacitor, one can obtain a pulse length at the output of the vacuum-to-pulse length converter that is 3-5 times than when using a magnet that controls the windings of a transformer in a blocking oscillator by inductance.

Claim

An instrument for measuring the smoothness of paper, which consists of a measurement vacuum chamber connected to a vacuum pump and a glass plate, a weight for clamping a sample, a vacuum-to-pulse length converter with Bourdon tube, which is connected to the measurement chamber, and, connected in series, a reference oscillator, switch, vacuum threshold measurement circuit and time measurement counter, which is distinguished by the fact that, with the goal of increasing the measurement accuracy by increasing sensitivity, the vacuum-to-pulse length converter consists of two reference voltage sources, two current sources of opposite polarity, a controlled current source, series-connected with the reference voltage source, a reference circuit, the input of which is connected to the second reference voltage source, a commutator and a flip-flop, and the Bourdon tube is provided with measurement and shield electrodes, and the shield electrode is connected to the common bus, and the measurement electrode is connected to the outputs of the current sources of opposite polarity and the controlled current source, the second input of the reference circuit and the input of the commutator, the output of which is connected to the common bus, and the second input of the commutator is connected to one of the outputs of the flip-flop, the second output of which is connected to the switch, and the input is connected to the output of the reference circuit and to the output of the reference voltage source that is connected to the input of the controlled current source.

Sources of information considered in examiner's appraisal:

1. USSR Inventor's Certificate Patent No. 2338026/23-12, Cl. G 01 N 33/00, 1976.

//insert figure//

Key: 1 Reset
2 Timing